On-chamber Fiber Testing

Procedure

Evaldas Juska (TAMU)

- **Fiber documentation**
  - Technical specs and mapping:
    https://edms.cern.ch/ui/file/2406136/1/GE21_fibers_on_chamber_technical_specs.pdf
  - OH optical interface:
    https://edms.cern.ch/ui/file/2512093/1/GE2_1_fibers_interface_to_OH.pdf

- **Connect the fiber in loopback**
  - Connect all LCD#A to LCD#B
  - For GBT fiber:
    LCD1A to LCD1B
    LCD2A to LCD2B
    LCD3A to LCD3B

    ……..
  - For Trigger fiber:
    LCD1A to LCD1B
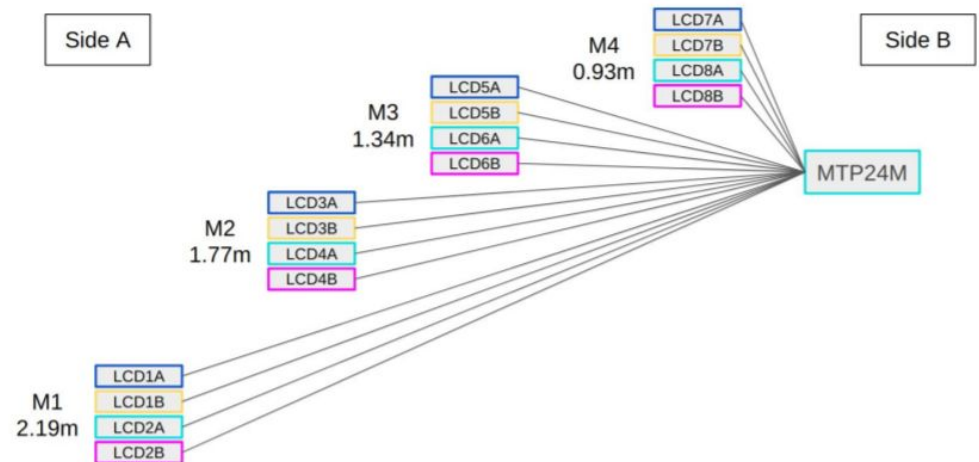   LCD2A to LCD2B
    LCD3A to LCD3B
    LCD4A to LCD4B

Figure 1: GE21_C1 fanout assembly

- **Run the fiber test procedure on the backend (see next slide)**
  - Measure the light level coming back to the receivers
  - Also runs GBT data through the links and checks GBT lock and FEC error cnt
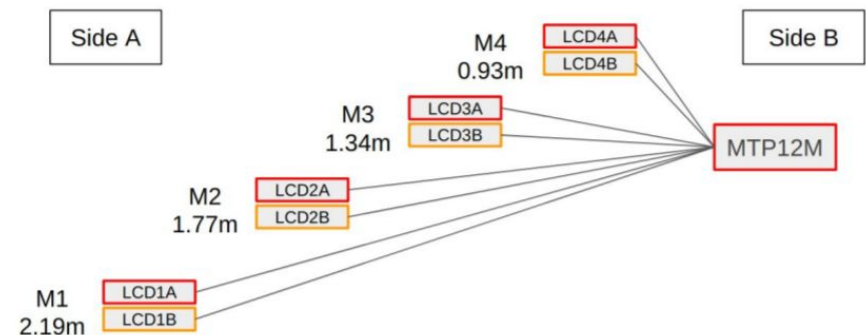 - Print the info, and PASS / FAIL

Figure 2: GE21_C5 fanout assembly

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Procedure

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- **The script always tests all OHs supported by the firmware**
  - If you see less than 4 OHs reported by the script, you need to upgrade backend firmware to with support for at least 4 OHs
  - When testing GBT fibers, all 4 OHs must pass
  - When testing trigger fibers, only 2 OHs are used per fiber bundle
    - If testing only one bundle, connect it to QSFP #0 – in this case OH0 and OH1 must pass
    - You can test two bundles at the same time by connecting them to QSFP #0 and QSFP #1

- **Test script**
  - The script supports two modes:
    - Loopback: use this mode when testing fibers in loopback
    - Normal: use this mode if you want to test both the fibers and VTRX (fibers connected to OH)
  - Run the script: python3 gem/fiber_test.py <mode>, e.g.:
    - python3 gem/fiber_test.py loopback
    - python3 gem/fiber_test.py normal
  - Script measures received light power, and prints pass/fail
  - Script measures GBT lock and FEC errors down to a Bit Error Rate of 10^{-10}, prints pass/fail
    - This measurement only takes ~3 seconds
  - Script then asks if you would like to make a more thorough Bit Error Rate test
    - If the quick test passed, and time permits, please do a BER test to 10^{-12} by entering 12
      - BER test down to 10^{-12} is industry standard
      - This takes 3.5 minutes (progress is reported every 10% to make it seem faster :))
    - If you don't want to run the longer test, just press enter
  - Sample output of the script in the next slide

Procedure

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```
Configuring the links for loopback

>>>>>>> OPTICAL POWER TEST <<<<<<<
---- OH0 ----
GBT0 RX power: 958uW (PASS)
GBT1 RX power: 1113uW (PASS)
---- OH1 ----
GBT0 RX power: 1256uW (PASS)
GBT1 RX power: 1044uW (PASS)
---- OH2 ----
GBT0 RX power: 0uW (FAIL)
GBT1 RX power: 0uW (FAIL)
---- OH3 ----
GBT0 RX power: 0uW (FAIL)
GBT1 RX power: 0uW (FAIL)

>>>>>>> QUICK GBT LOCK AND FEC ERROR TEST TO BER 10^10 <<<<<<<
Waiting for 2 seconds to allow 10^10 bits to pass through for error counting...
    progress: 10%
    progress: 20%
    progress: 30%
    progress: 40%
    progress: 50%
    progress: 60%
    progress: 70%
    progress: 80%
    progress: 90%
    progress: 100%
---- OH0 ----
GBT0 locked = 1, had unlocks = 0, FEC error count = 0 (PASS)
GBT1 locked = 1, had unlocks = 0, FEC error count = 0 (PASS)
---- OH1 ----
GBT0 locked = 1, had unlocks = 0, FEC error count = 0 (PASS)
GBT1 locked = 1, had unlocks = 0, FEC error count = 0 (PASS)
---- OH2 ----
GBT0 locked = 0, had unlocks = 1, FEC error count = 0 (FAIL)
GBT1 locked = 0, had unlocks = 1, FEC error count = 0 (FAIL)
---- OH3 ----
GBT0 locked = 0, had unlocks = 1, FEC error count = 0 (FAIL)
GBT1 locked = 0, had unlocks = 1, FEC error count = 0 (FAIL)

Would you like to do a longer and more thorough FEC error test? If yes, please enter the BER power to test to (12 is the industry standard,
 would take around 3.5 minutes):12

>>>>>>> GBT LOCK AND FEC ERROR TEST TO BER 10^12 <<<<<<<
Waiting for 208 seconds to allow 10^12 bits to pass through for error counting...
    progress: 10%
    progress: 20%
    progress: 30%
    progress: 40%
    progress: 50%
    progress: 60%
    progress: 70%
    progress: 80%
    progress: 90%
    progress: 100%
---- OH0 ----
GBT0 locked = 1, had unlocks = 0, FEC error count = 0 (PASS)
GBT1 locked = 1, had unlocks = 0, FEC error count = 0 (PASS)
---- OH1 ----
GBT0 locked = 1, had unlocks = 0, FEC error count = 0 (PASS)
GBT1 locked = 1, had unlocks = 0, FEC error count = 0 (PASS)
---- OH2 ----
GBT0 locked = 0, had unlocks = 1, FEC error count = 0 (FAIL)
GBT1 locked = 0, had unlocks = 1, FEC error count = 0 (FAIL)
---- OH3 ----
GBT0 locked = 0, had unlocks = 1, FEC error count = 0 (FAIL)
GBT1 locked = 0, had unlocks = 1, FEC error count = 0 (FAIL)

Configuring the links for normal operation
```

Script output when testing a single MTP12 cable in loopback (like trigger fiber test)